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# AGARD

ADVISORY GROUP FOR AEROSPACE RESEARCH & DEVELOPMENT

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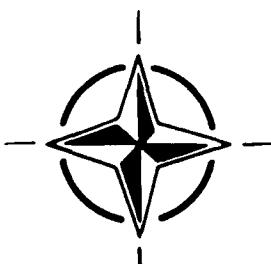
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## Technical Programme 1993

(Le Programme Technique, 1993)

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NORTH ATLANTIC TREATY ORGANIZATION

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## **The Mission of AGARD**

According to its Charter, the mission of AGARD is to bring together the leading personalities of the NATO nations in the fields of science and technology relating to aerospace for the following purposes:

- Recommending effective ways for the member nations to use their research and development capabilities for the common benefit of the NATO community;
- Providing scientific and technical advice and assistance to the Military Committee in the field of aerospace research and development (with particular regard to its military application);
- Continuously stimulating advances in the aerospace sciences relevant to strengthening the common defence posture;
- Improving the co-operation among member nations in aerospace research and development;
- Exchange of scientific and technical information;
- Providing assistance to member nations for the purpose of increasing their scientific and technical potential;
- Rendering scientific and technical assistance, as requested, to other NATO bodies and to member nations in connection with research and development problems in the aerospace field.

The highest authority within AGARD is the National Delegates Board consisting of officially appointed senior representatives from each member nation. The mission of AGARD is carried out through the Panels which are composed of experts appointed by the National Delegates, the Consultant and Exchange Programme and the Aerospace Applications Studies Programme. The results of AGARD work are reported to the member nations and the NATO Authorities through the AGARD series of publications of which this is one.

Participation in AGARD activities is by invitation only and is normally limited to citizens of the NATO nations.

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## **Preface**

This publication presents the 1993 Technical Programme of AGARD. Section I includes a chronological listing of the meetings tentatively scheduled to take place during the year and Section II gives a detailed description of the individual Panel Programmes, the Consultant and Exchange Programme, the Support Programme to Greece, Portugal and Turkey, and the Military Committee Studies Programme. Some publications in Section II are marked with an asterisk(\*). They are tentatively scheduled for 1993 subject to funds being made available. The Publication Summary in Section III identifies by activity the AGARD publications scheduled for publication during the year.

## **Préface**

Cette publication présente le Programme Technique de l'AGARD pour 1993 tel qu'il a été approuvé par le Conseil des Délégués Nationaux. La Section I présente une liste chronologique provisoire des réunions programmées pendant l'année et la Section II donne une description détaillée du Programme de chacun des Panels, du Programme des Consultants et des Echanges, du Programme d'Aide à la Grèce, au Portugal et à la Turquie, et du Programme des Etudes pour le Comité Militaire. Certaines publications figurant à la Section II sont indiquées par un astérisque(\*). Elles devraient paraître en 1993, sous réserve de la disponibilité des fonds nécessaires. Le Récapitulatif des Publications dans la Section III répartit par activité les publications de l'AGARD devant être éditées au cours de l'année.

A.J. Wennerstrom  
Director

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**I—Tentative Calendar of  
AGARD Meetings  
1993**

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**Tentative Distribution of AGARD Meetings by Nations in 1993**  
**Distribution Provisoire des Réunions AGARD dans les Nations en 1993**

	PANEL MEETINGS		LECTURE SERIES/SPECIAL & SHORT COURSES		TOTAL
	SPRING	FALL	SPRING	FALL	
BELGIUM		FDP 4- 8 Oct	FDP/VKI SpC#1 (VKI) 24-28 May FDP/VKI SpC#2 (VKI) 29 March-2 April	AMP LS 189 28-29 Oct	4
CANADA	AMP 17-21 May	PEP 4- 8 Oct TIP 4- 8 Oct	SMP LS 190 3-4 June		4
DENMARK					0
FRANCE	NDB* 1- 2 April AVP 10-14 May	SMP 3- 8 Oct	GCP LS 191 16-18 June		4
GERMANY	GCP 10-14 May (Berlin) MCS* 22-25 June		PEP LS 188 7-8 June		3
GREECE			SMP LS 190 29-30 April	AMP LS 189 1-2 Nov	2
ICELAND					0
ITALY	TIP 26-30 April PEP 10-14 May	NDB* 15-17 Sept	FDP SC 31 May-1 June		4
LUXEMBOURG					0
NETHERLANDS	FMP 24-28 May	EPP 4- 8 Oct		AMP Short Course	3
NORWAY		AVP* 18-22 Oct		AVP LS 192 11-12 Oct	2
PORTUGAL		AMP 18-22 Oct	SMP LS 190 3-4 May	AMP LS 189 25-26 Oct	3
SPAIN	EPP* 17-21 May		FDP SpC#2 22-26 March	AVP LS 192 14-15 Oct	3
TURKEY	SMP 18-23 April		FDP SC 27-28 May SMP LS 190 26-27 April PEP LS 188 10-11 June	AMP LS 189 4-5 Nov	5
UK	FDP 19-23 April	MCS* Nov	FDP SC 3- 4 June FMP/Cranfield SC		4
USA		FMP 18-22 Oct GCP 11-15 Oct	PEP LS 188 15-16 June GCP LS 191 9-11 June	AVP LS 192 14-15 Sept	5
<b>TOTAL</b>	<b>11 (3 classified)*</b>	<b>11 (4 classified)*</b>	<b>16</b>	<b>8</b>	<b>46</b>

**Tentative Calendar of AGARD Meetings 1993**  
**Calendrier Provisoire des Réunions AGARD en 1993**

Dates Dates	Location Lieu	Panel Panel	Type of Meeting/Subject Type/Sujet de Réunion
22-26 MARCH	SPAIN	FDP	Special Course No 2 on "Progress in Transition Modelling" <b>Cours Spécial No 2 sur</b> <b>"Les Progrès dans la Modélisation</b> <b>de la Transition"</b>
29 MARCH- 2 APRIL	BELGIUM (VKI)		
1-2 APRIL	FRANCE (Bordeaux)	HQ	NATIONAL DELEGATES BOARD MEETING (CLASSIFIED) preceeded by - Panel Chairmen's Meeting (30 March) - National Coordinators' Meeting (31 March) - Steering Committee Meeting (31 March) <u>NATO SECRET</u> <b>REUNION DU CONSEIL DES DELEGUES</b> <b>NATIONAUX (CLASSIFIÉE) précédée des</b> - Réunion des Présidents de Panel (30 mars) - Réunion des Coordonnateurs Nationaux (31 mars) - Réunion du Comité d'Orientation (31 mars) <u>SECRET OTAN</u>
18-23 APRIL	TURKEY (Antalya)	SMP	Panel Meeting and 1. Workshop on "Introduction of Ceramics into Aerospace Structural Composites" 2. Workshop on "Integrated Airframe Design Technology" <b>Réunion du Panel et</b> 1. Atelier de Travail sur "L'Introduction des Céramiques dans les Composites Utilisés dans les Structures de Systèmes Aérospatiaux" 2. Atelier de travail sur "Les Technologies pour la Conception Intégrée des Cellules"
19-23 APRIL	UNITED KINGDOM (Winchester)	FDP	Panel Meeting/Symposium on "Computational and Experimental Assessment of Jets in Cross Flow" <b>Réunion du Panel et Symposium</b> <b>sur "L'Evaluation Expérimentale et</b> <b>Informatisée des Jets dans les Ecoule-</b> <b>ments Transverses"</b>
26-30 APRIL	ITALY (Rome)	TIP	Panel Business Meeting <b>Réunion de Travail du Panel</b>

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Dates Dates	Location Lieu	Panel Panel	Type of Meeting/Subject Type/Sujet de Réunion
<hr/>			
26-27 APRIL	TURKEY (Ankara)	SMP	Lecture Series 190 on "A Recommended Methodology for Quantifying Non Destructive Inspection and Evaluation (NDI/NDE) Based on Aircraft Engine Experience" <b>Cycle de Conférences No 190 sur</b> <b>"Le Projet de Méthodologie pour</b> <b>l'Evaluation du Contrôle non</b> <b>Destructif Fondé sur l'Expérience</b> <b>acquise sur les Moteurs d'Avions"</b>
29-30 APRIL	GREECE (Patras)		
3-4 MAY	PORTUGAL (Lisbon)		
3-4 JUNE	CANADA (Ottawa)		
10-14 MAY	ITALY (Rome)	PEP	Panel Meeting/Symposium on "Fuels and Combustion Technology for Advanced Aircraft Engines" <b>Réunion du Panel et Symposium sur</b> <b>"Les Propergols et les Systèmes</b> <b>de Combustion pour les Moteurs</b> <b>d'Aéronefs"</b>
10-14 MAY	FRANCE (Paris)	AVP	Panel Meeting/Symposium on "Aerospace Software Engineering for Advanced System Architectures" <b>Réunion du Panel et Symposium sur</b> <b>"L'Ingénierie des Logiciels pour les</b> <b>Architectures de Systèmes Aérospatiaux"</b>
10-14 MAY	GERMANY (Berlin)	GCP	Panel Meeting/Symposium on "Machine Intelligence in Air Traffic Management" <b>Réunion du Panel et Symposium sur</b> <b>"L'Intelligence Artificielle Appliquée à</b> <b>la Gestion du Trafic Aérien"</b>
17-21 MAY	CANADA (Victoria)	AMP	Panel Meeting/Symposium on "Air Operations in Extreme Hot and Cold Environments" <b>Réunion du Panel et Symposium sur</b> <b>"Les Opérations Aériennes en Environnement</b> <b>Extrême Chaud/Froid"</b>
17-21 MAY	SPAIN	EPP	Panel Meeting/Symposium on "Atmospheric Propagation Effects through Natural and Man-made Obscurants for Visible mm-wave Radiation" <u>NATO SECRET</u> <b>Réunion du Panel et Symposium</b> <b>sur "Les Effets de la Propagation</b> <b>Atmosphérique à travers des Obscurcissants</b> <b>Naturels et Artificiels sur le Rayonnement</b> <b>des Ondes Millimétriques"</b> <u>SECRET OTAN</u>

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Dates Dates	Location Lieu	Panel Panel	Type of Meeting/Subject Type/Sujet de Réunion
24-28 MAY	NETHERLANDS (The Hague)	FMP	Panel Meeting/Symposium on "Recent Advances in Long Distance/Long Endurance Operations" <b>Réunion du Panel/Symposium</b> <b>sur "Les Récentes Avancées dans le</b> <b>Domaine des Opérations à Longue Distance</b> <b>et de Longue Durée"</b>
24-28 MAY	BELGIUM (VKI)	FDP	Special Course No 1 on "Shock Wave/Boundary Layer Interaction in Supersonic and Hypersonic Flows" <b>Cours Spécial No 1 sur</b> <b>"Interaction entre l'Onde de Choc et la</b> <b>Couche Limite dans les Flux Supersoniques</b> <b>et Hypersoniques"</b>
27-28 MAY 31 MAY- 1 JUNE 3-4 JUNE	TURKEY (Ankara) ITALY (Turin) UNITED KINGDOM (Manchester)	FDP	Short Course on "Aerodynamics of Manoeuvring Aircraft" <b>Cours sur "L'Aérodynamique des Avions</b> <b>durant leurs Manoeuvres"</b>
SPRING	UNITED KINGDOM (Cranfield)	FMP	Short Course on "Flight Test Instrumentation" <b>Cours sur "L'Instrumentation pour</b> <b>les Essais en Vol"</b>
7-8 JUNE 10-11 JUNE 15-16	GERMANY (Neubiberg) TURKEY (Ankara) USA (Monterey)	PEP	Lecture Series 188 on "Rocket Motor Plume Technology" <b>Cycle de Conférences No 188 sur</b> <b>"L'Etude des Jets des Moteurs-fusées"</b>
9-11 16-18 JUNE	USA (Stanford) FRANCE (Sofia Antipolis)	GCP	Lecture Series 191 "Non-linear Dynamics and Chaos" <b>Cycle de Conférences No 191 sur</b> <b>"La Dynamique non-linéaire et le Chaos"</b>
22-25 JUNE	GERMANY (Ottobrun)	AASC	Meeting of the AASC <u>NATO SECRET</u> <b>Réunion de l'AASC</b> <u>SECRET OTAN</u>
14-15 SEPT 11-12 OCT 14-15 OCT	US NORWAY (Kjeller) SPAIN (Madrid)	AVP	Lecture Series 192 on "New Advances in Mission Planning and Rehearsal Systems" <b>Cycle de Conférences No 192 sur</b> <b>"Les Nouvelles Approches pour les Systèmes</b> <b>de Planification et de Simulation</b> <b>des Missions"</b>

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Dates Dates	Location Lieu	Panel Panel	Type of Meeting/Subject Type/Sujet de Réunion
15-17 SEPT	ITALY (Rome)	HQ	<p>NATIONAL DELEGATES BOARD MEETING  <u>(CLASSIFIED)</u> and NATIONAL DAY  preceeded by Panel Chairmen's Meeting  (14 September)</p> <p>REUNION DU CONSEIL DES DELEGUES  NATIONAUX <u>(CLASSIFIEE)</u> et  JOURNÉE NATIONALE précédée par la  Réunion des Présidents de Panel  (14 Septembre)</p>
3-8 OCT	FRANCE	SMP	<p>Panel Meeting</p> <p>1. Workshop on an "Assessment of Fatigue Damage and Crack Growth Prediction Techniques"</p> <p>2. Workshop on "Characterization of Fibre Reinforced Titanium Metal Matrix Composites (MMCs)"</p> <p>Réunion du Panel et</p> <p>1. Atelier de Travail sur "L'Evaluation de l'Endommagement dû à la Fatigue et les Techniques de Prédition de la Propagation des Fissures"</p> <p>2. Atelier de Travail sur "La Caractérisation des Matériaux Composites à Matrice Métallique Renforcée par Fibres de Titane"</p>
18-22 OCT	NORWAY	AVP	<p>Panel Meeting/Symposium on  "The Challenge of Future EW System Design"</p> <p><u>NATO SECRET</u></p> <p>Réunion du Panel et Symposium  sur "Les Défis posés par la Conception des Futurs Systèmes E. W."</p> <p><u>SECRET OTAN</u></p>
4-8 OCT	NETHERLANDS (Rotterdam)	EPP	<p>Panel Meeting/Symposium on  "Multiple Mechanism Propagation Paths (MMPP) : Characterization and Influence on System Design"</p> <p>Réunion du Panel et Symposium sur  "Les Trajets de Propagation des Ondes à Mécanismes Multiples (MMPP) : Caractères et Incidence sur la Conception des Systèmes"</p>
4-8 OCT	BELGIUM (Brussels)	FDP	<p>Panel Meeting/Symposium on  "Wall Interference, Support Interference and Flow Field Measurements"</p> <p>Réunion du Panel et Symposium  sur "Les Effets de Paroi et de Support et les Mesures des Champs d'Ecoulement"</p>

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Dates Dates	Location Lieu	Panel Panel	Type of Meeting/Subject Type/Sujet de Réunion
4-8 OCT	CANADA (Montreal)	PEP	Panel Meeting/Symposium on "Technology Requirements for Small Gas Turbines" <b>Réunion du Panel et Symposium sur "Les Technologies pour les Petites Turbines à Gaz"</b>
4-8 OCT	CANADA (Ottawa)	TIP	Panel Meeting/Specialists' Meeting on "International High Speed Networks for Scientific and Technical Information Programmes" <b>Réunion du Panel/Réunion de Spécialistes sur "Les Réseaux Internationaux à Grande Vitesse pour les Programmes d'Information Scientifique et Technique"</b>
11-15 OCT	USA	GCP	Panel Meeting/Symposium on "Pointing and Tracking Systems" <u>CLASSIFIED</u> <b>Réunion du Panel et Symposium sur "Les Systèmes d'Acquisition et de Poursuite" <u>CLASSIFIES</u></b>
18-22 OCT	PORUGAL (Lisbon)	AMP	Panel Meeting/Symposium on "Virtual Interfaces : Research and Applications" <b>Réunion du Panel et Symposium sur "Les Interfaces Virtuelles entre Recherche et Applications"</b>
18-22 OCT	USA (Annapolis)	FMP	Panel Meeting/Symposium on "Technologies for Highly Manoeuverable Aircraft" <b>Réunion du Panel/Symposium sur "Les Technologies pour les Aéronefs à Haute Manoeuvrabilité"</b>
25-26 OCT 1-2 4-5 NOV	PORUGAL (Lisbon) BELGIUM (Brussels) GREECE (Athens) TURKEY (Ankara)	AMP	Lecture Series 189 on "Cardiopulmonary Aspects in Aerospace Medicine" <b>Cycle de Conférences No 189 sur "Les Aspects Cardiopulmonaires en Médecine Aérospatiale"</b>
FALL	NETHERLANDS (Soesterberg)	AMP	Short Course on "Operational Uses of Contact Lenses by Military Aircrew" <b>Cours sur "L'Utilisation en Opérations des Lentilles de Contact par les Equipages Militaires"</b>
NOV	UNITED KINGDOM (London)	AASC	Meeting of the AASC <u>NATO SECRET</u> <b>Réunion de l'AASC <u>SECRET OTAN</u></b>

## Panel Titles

AASC	Aerospace Applications Studies Committee Comité pour les Etudes en vue d'Applications Aérospatiales
AMP	Aerospace Medical Panel Panel de Médecine Aérospatiale
AVP	Avionics Panel Panel d'Avionique
EPP	Electromagnetic Wave Propagation Panel Panel sur la Propagation des Ondes Electromagnétiques
FMP	Flight Mechanics Panel Panel de la Mécanique du Vol
FDP	Fluid Dynamics Panel Panel de la Dynamique des Fluides
GCP	Guidance and Control Panel Panel du Guidage et du Pilotage
PEP	Propulsion and Energetics Panel Panel de Propulsion et d'Energetique
SMP	Structures and Materials Panel Panel des Structures et des Matériaux
TIP	Technical Information Panel Panel de l'Information Technique
MCS	Military Committee Studies (Division) Etudes pour le Comité Militaire (Division)
HQ	Headquarters Etat-Major

## II—Programme Descriptions 1993

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## Aerospace Medical Panel

Chairman	: Prof G. SANTUCCI, France
Deputy Chairman	: Dr L. VOGT, Germany
Executive	: Major W.D. LYLE, Canada

### 1993 TECHNICAL PROGRAMME

In 1993 the Aerospace Medical Panel will hold two Symposia, sponsor one Lecture Series, one Short Course and form one new Working Group. A number of projects for training in aeromedical topics will be continued under the Support to Greece, Portugal and Turkey Programme.

#### SYMPOSIA

Spring Meeting, Canada, May 1993:

##### **The Support of Air Operations Under Extreme Hot and Cold Weather Conditions**

###### Cold Weather

Cold weather affects all aspects of air operations. For aircrew under normal operations, it means the burden of wearing bulky winter flying coveralls. This makes tasks such as aircraft walk around and step-in slower, and manual tasks are much more difficult and potentially dangerous. Once strapped in, the human anthropometric measurements are increased and often present physical restrictions to those aircrew who are at the extremes of anthropometric measurements allowed in the cockpit. It also causes discomfort in long-haul flights and may cause difficulties in ejection and escape parameters.

Under emergency conditions of bail out, ejection and helicopter ditching, either on land or in cold water, all aircrew and passengers are at risk. If the immediate consequences of the accident are survived, the personnel may potentially die from simple hypothermia, a combination of hypothermia and drowning if the accident occurs in water, or suffer from a more chronic problem such as local injuries. The techniques and the primary and secondary treatment of such conditions still remain a topic of debate.

###### Hot Weather

At the other extreme, hot weather also affects all aspects of air operations. Depending on the conditions, aircrew and maintenance staff may suffer job performance difficulties on the one hand from the simple effects of sweat running into the eyes, or discomfort from the effects of wearing coveralls, flying gloves and aircrew life support equipment saturated with sweat. On the other hand, they may suffer loss of performance from all the effects of heat strain such as prickly heat, heat cramp, heat syncope, heat exhaustion and heat stroke. By the very nature of intense air operations, these problems are aggravated by physical work and the wearing of NBC clothing and respirators. This has all recently been borne out by the intense air operations in the Gulf War.

The programme will be Unclassified.  
Fall Meeting, Portugal, October 1993:

**Virtual Interfaces: Research and Applications**

Human performance using virtual interfaces is the main theme.

Designers of specialized or hybrid systems must be informed about the relative costs of implementation and the relative benefits in performance or new capabilities. Topics selected for this meeting are expected to inform those making decisions about where to implement (i.e. in which jobs), how to implement (hardware and software options) and what performance benefits to expect.

Human operators are presented within an ever-increasing amount of time critical information to which rapid responses are necessary. In the future, environmental, mission and task critical information may be emphasized in global, multimodal portrayals presented to operators of real-word dynamic systems. Design and implementation of such systems that optimally use Virtual Reality technologies must be constrained by results from benchmark tests of human performance. Such tests can be expected to result in demands for new requirements in computer hardware and software, sensors, and display technologies.

Advanced technologies in sensors, computers, and displays permit human operators to interactively engage computer-generated objects. Systems are being built to replace environments typically experienced with those that are computer-generated, and therefore "virtual". This symposium intends to foster the exchange of information that could lead to better designs at lower cost.

The programme will be Unclassified.

**LECTURE SERIES**

Lecture Series 189, Portugal, Belgium, Greece and Turkey, Fall 1993

**Cardiopulmonary Aspects in Aerospace Medicine**

The Lecture Series will provide the aeromedical specialist a thorough understanding of major clinical aerospace medical problems, such as arrhythmias, coronary disease, valvular disease, hypertension, bronchopulmonary disease and risk factors. The Lecture Series is planned for 2 days.

**WORKING GROUPS**

Working Group 18

**Echocardiographic Assessment of NATO Aircrew**

The NDB has extended this Working Group to December 1995 to enable it to collect sufficient data to make statistical decisions. The work will culminate in an AGARDograph which will be a significant reference text aiding medical decision making.

Working Group 19

**Psychophysiological Assessment Methods**

This Working Group started in early 1992 and will terminate in December 1993. An AGARDograph will be published which will provide member nations with recommendations concerning the use of psychophysiological measures in the aerospace environment. Currently available and emerging methods of data collection, storage and

analysis will be evaluated and recommendations will be made with regard to appropriate application areas for each method. This will also permit standardization of methods so that data can be shared among laboratories, thereby making more data available to scientists and engineers in member nations.

**Working Group 20****3-D Surface Anthropometry**

This Working Group will start in January 1993 and terminate in December 1994. It will review and determine the specific digitizing requirements for each member nation, establish both common and member specific measuring criteria for posture and clothing ensembles. They will develop a plan for the three dimensional anthropometric surveys in the member nations.

**SHORT COURSE**

The Netherlands, September 1993

**Operational Uses of Contact Lenses by Military AircREW**

AMP Working Group 16 was recently completed and this 3 day course will provide available information from practical experience and experimental studies to offer guidelines for the operational use of contact lenses by the various categories of aircrew.

**PUBLICATIONS**

**Cardiopulmonary Aspects in Aerospace Medicine**  
Lecture Series Notes, April 1993

**The Support of Air Operations Under Extreme Hot and Cold Weather Conditions**

Conference Proceedings, July 1993

**Interactive Multi-Media Ergonomics Database on CD-ROMs**  
User Manual and Jewel Box, August 1993

**\*Evolution of the Anti-G Suits, their Limitations and Alternative Methods for Avoidance of G-Induced Loss of Consciousness**  
AGARDograph, September 1993

**\*Les Ailes d'Esculape (The Wings of Aesculapius)**  
AGARDograph, September 1993

**Virtual Interfaces: Research and Applications**  
Conference Proceedings, November 1993

**Psychophysiological Assessment Methods**  
AGARDograph, December 1993

**SUPPORT PROGRAMME**

In 1993 the Panel will sponsor 12-15 projects with Greece, Portugal and Turkey. In keeping with current Panel practice, the Panel Sub-Committee will review requests from the supported Nations and endorse a priority listing of projects. Most projects are predicted to be individual training opportunities in aerospace medical topics but we are encouraging more possibilities for joint research projects, particularly in the Nations with new Aerospace Medical/Physiological Training Centers.

\*subject to funds being made available

## **Avionics Panel**

**Chairman:** Mr Jose M.G.B. MASCARENHAS, Portugal  
**Deputy Chairman:** Col. Francis CORBISIER, Belgium  
**Executive:** LTC F. Christian SAUTTER, US Army

### **1993 PROGRAMME**

The Avionics Panel will organize and conduct two Symposia and sponsor one Lecture Series. In support of the various panel initiatives there will be five documents published.

Action will continue on active working groups 14 and 16 which will conclude their activities during 1993. There are no new working groups planned for this period.

The Panel will continue their active support of projects in Greece, Portugal and Turkey while initiating one new program in Portugal.

### **MEETINGS**

Spring Symposium, Paris, France, May 1993

#### **Aerospace Software Engineering for Advanced System Architectures**

Software engineering techniques are lagging far behind in their development, application, and formal underpinnings, compared with hardware. There is no uniform, formal discipline solution to the problem of software engineering. Its current state of evolution displays wide variances among different domain (application) areas. The aerospace electronics field however, constitutes a potential domain that can exploit much of the current science and art of software engineering, that can result in order-of-magnitude enhancements in system performance while providing economic advantages to the consumer.

During the past decade, more and more traditional hardware functions have been performed by software. The introduction of "integrated aerospace electronics", implemented with common modules, hardware resource sharing, and dynamically adaptable configurations for fault tolerance, have represented new challenges to the aerospace electronic community, and have forced our attention to software as being the limiting science for further system development. The explosion of computer applications that followed the availability of low-cost computer hardware has resulted in the current demand for software exceeding our ability to supply that software, and the gap between supply and demand is increasing. In addition, our ability to produce needed software exceeds our ability to maintain it. Effective software engineering techniques must apply if we are to have any chance of reducing or controlling these imbalances.

Topics to be included in the symposium will be covered in the following sessions:

- Aerospace Electronics Software Specifications
  - Requirements Engineering
- Software Design
  - Object-Oriented Design
  - Function-Oriented Design
- Programming Practices, and Techniques
- Software Validation and Testing
- Software Management
- Software Environments

Fall Symposium, Norway, October 1993

**The Challenge of Future EW System Design (Classified Meeting)**

Electronic Warfare has emerged as a critical driving force in modern warfare. The wide mix of varying generations of weapon systems, brought on by changes in the traditional political alliances, directly impact EW requirements and strategies.

Modern combat aircraft are faced with a drastic change in the threat scenario consisting of a mix of western and eastern weapon systems. The deployment of advanced pulse doppler radar systems in A/A and G/A application augmented by extensive electro-optic capabilities and the possible future introduction of directed energy weapons (laser or particle beam), requires a detailed reassessment of NATO EW techniques including low probability of intercept provisions and stealth techniques.

The complexity and diversity of future threat scenarios necessitate changes in NATO EW system concepts. These include update of existing equipment, modifications of tactics, and combinations of EW resources to improve survivability. In this light the symposium shall serve to review the driving factors for revised NATO EW concepts and architectures. It will also identify key technological thrusts in EW contribution to the threat environment. In the following five session it is hoped that the necessary interaction between representatives of the military, government, academia, and industry will be able to effectively address these areas of need:

- Threat scenario changes and projected requirements
- New EW concepts and architectures
- Emerging EW technologies
- EW systems and equipment
- Testing and System Support

**LECTURE SERIES**

Lecture Series LS-192, US, NO, SP, September-October 1993

**New Advances in Mission Planning and Rehearsal Systems**

Modern data processing technology with greatly enhanced capabilities is being used in both the airborne and ground-based segments of the NATO Air Forces. A key element in the interface between these segments is provided by the mission planning systems which are used to analyze, fuse and refine the information at air bases. This information is used to generate the mission plans before they are loaded into the aircraft's avionics system for use during the mission. The synergy of modern avionics systems and ground-based data networks cannot be fully realized unless mission data is provided effectively and rapidly to aircraft before the mission is commenced. AircREW workloads must be minimized, both before and during flight, by the development of user-friendly planning systems which incorporate rehearsal facilities. The report from Joint Working Group 15, "Mission Planning Systems for Tactical Aircraft", will be used as the basis for this lecture series.

**WORKING GROUPS**

Working Group 14

**Integrated C3I Systems for Future Air and Space Operations**

(duration 2 years), will be completed in December 1993. The Advisory Report will be published in 1994.

Working Group 16

**Tactical Space Systems (TACCSATS) for NATO**

will finish in June 1993. The results of the Working Group will be published in an Advisory Report in September 1993.

**SUPPORT PROGRAMME**

The Avionics Panel will continue to support approximately four Support Projects with Greece, Portugal and Turkey. One new project with Portugal has been identified and will be implemented in 1993.

**PUBLICATIONS**

**Aerospace Software Engineering for Advanced System Architectures**  
Conference Proceedings, June 1993

**New Advances in Mission Planning and Rehearsal Systems**  
Lecture Series 192- Notes, September 1993

**Tactical Space Systems (TACCSATS) for NATO**  
Advisory Report, December 1993

**The Challenge of Future EW System Design**  
Conference Proceedings, December 1993

**The Challenge of Future EW System Design**  
CLASSIFIED Supplement, December 1993

## Electromagnetic Wave Propagation Panel

Chairman : Dr J.H. Richter, US  
Deputy Chairman: Dr D.H. Höhn, GE  
Executive : Lt-Col. R. Cariglia, IAF, IT

### 1993 PROGRAMME

In 1993 the Electromagnetic Wave Propagation Panel will organise and conduct two symposia and continue its Working Group activities. The Panel will support several projects for Greece, Portugal and Turkey and will produce a number of publications to document its activities for the use of the NATO scientific community.

### MEETINGS

Spring 1993 Specialists' Meeting, Spain, May 1993:

#### **Atmospheric Propagation Effects Through Natural and Man-Made Obscurants for Visible to mm-Wave Radiation (NATO SECRET).**

Modern, precision-guided weapons require that guidance and target acquisition/recognition systems take into account the effects of the propagation environment. Successful performance must be obtained under adverse weather conditions such as haze, clouds, fog, rain, snow and under adverse battlefield conditions such as dust, smoke and man-made obscurants.

Sensors operate at wavelengths ranging across the millimeter, IR and the visible regions of the electromagnetic spectrum. Propagation effects vary drastically over this wavelength span and systems may employ a combination of sensors to mitigate adverse environmental conditions. The effectiveness of countermeasures such as multispectral obscurants and multispectral camouflage also depends on atmospheric properties.

System performance is measured in terms of probability of detection, probability of recognition and, ultimately, in terms of probability of a kill. A partial listing of the processes that affect these probabilities and, in turn, are affected by the propagation environment includes extinction, angles and amplitude scintillation, target to background contrast, contrast transmission and clutter characteristics.

The symposium will address the following topics:

#### Natural obscurants:

- The effects of natural obscurants (haze, clouds, fog, rain, snow and dust) on system performance.

#### Man-made obscurants and battlefield-induced phenomena:

- The effects of man-made smokes, battlefield-induced smokes and enhanced scintillation on system performance.

**Target and background signatures:**

- Atmospheric effects on target and background signatures, and target to background contrast.

**Multispectral camouflage:**

- Weather-related propagation effects on camouflage and obscurants effectiveness and contrast reduction.
- Theoretical and/or experimental evaluation of camouflage effectiveness.

**System mitigation aspects:**

- Methods to mitigate the above-mentioned factors e.g. image processing, sensor fusion, tactical weather intelligence, and tactical decision aids.

Fall Symposium, the Netherlands, October 1993:

**Multiple Mechanism Propagation Paths (MMPP): their Characterisation and Influence on System Design.**

There are many operational situations in which EM energy, whilst nominally being transferred via a specific propagation mechanism, may also be transferred by other distinct mechanisms. The mechanisms may have very different characteristics in terms of delay, Doppler spreading, time dispersion, range, etc.., which should be taken into account in the design of systems operating in that environment. Although multiple mechanisms may cause complications in system architectures and operating procedures, they also have the potential to enhance the reliability and survivability - particularly of communications systems - if they can be characterised in real-time and their presence anticipated in the systems design.

Examples of comparatively simple situations involving multiple mechanisms include:

- . conventional line-of-sight paths (terrestrial and satellite) in which energy propagates by the direct route and also via a sea or ground reflection (including radar clutter problems);
- . ionospheric skywave paths in which refraction takes place in two or more distinct layers.

At a more complex level typical situations are:

- . MF/HF groundwave propagation in which there is interference from ionospherically-refracted skywave modes;
- . microwave or UHF mobile radio relay line-of-sight links which are also affected by troposcatter propagation and "ducting";
- . beyond line-of-sight propagation in the HF/VHF band, up to say about 100 MHz where energy transfer can take place via groundwave, normal skywave, sporadic E, ionoscatter, meteor-burst, troposcatter and other irregular modes (e.g. auroral scatter).

The symposium will address the following topics:

- off-line (analytical) and real-time characterisation of Multiple-Mechanism Propagation Paths (MMPPs);

- ways of exploiting MMPPs, or of selecting specific mechanisms in such an environment;
- modelling and simulation;
- spectrum utilisation, frequency planning and coverage implications;
- adaptive systems design to operate in the MMPP environment;
- new techniques with potential to provide improved performance over MMPPs.

**WORKING GROUP**

EPP/WG-04:

**HF Band Congestion**

Ionospheric forecasts have been developing for half a century and a lot of methods have been implemented for long/short time predictions. The spectrum occupancy of the HF band has been rapidly growing during the last thirty years. Since 1980, studies have been conducted on the modeling and measurements of the interference.

The modeling of interference is of great interest in the field of communications and remote sensing were technical advances are important. Methods have been developed in order to mitigate interference effects and progress are expected for the years to come.

The first task of this Working Group will be to make an analysis of known results on interference modeling, and of problems limiting the present systems.

Its second task will be to review the future methods of modeling and their implementation, in order to mitigate the effects of interference, through the use of forecasting and/or modern signal processing.

**SUPPORT PROGRAMME**

The Panel will support the following projects:

- G-72, with Greece, entitled "Electromagnetic Interference and Compatibility (EMI/EMC)", started in 1991 and will end in 1993.
- P-76, with Portugal, entitled "Exploratory Activity in Relation to Studies on the 20-30 GHz Frequency Bands Using Olympus Satellite", started in 1991 and will end in 1993.
- T-72, with Turkey, entitled "Investigation of the Effects of Atmospheric Turbulence on the Performance of Tactical Atmospheric Optical Data Links" started in 1992 and will end in 1994.
- T-73, with Turkey, entitled "Support for HF Fading Experiments in Turkey", started in 1992 and will end in 1994.

PUBLICATIONS

**Atmospheric Propagation Effects Through Natural and Man-Made Obscurants for Visible to mm-Wave Radiation.**  
Conference Proceedings, August 1993

**Atmospheric Propagation Effects Through Natural and Man-Made Obscurants for Visible to mm-Wave Radiation.**  
Conference Proceedings Supplement, August 1993

**Multiple Mechanism Propagation Paths (MMPP): their Characterisation and Influence on System Design.**  
Conference Proceedings, December 1993

## Flight Mechanics Panel

Chairman : ICA J-M. DUC, France  
Deputy Chairman : Prof. L.M.B. da Costa CAMPOS, Portugal  
Executive : Mr. M. K. FOSTER, United Kingdom

### 1993 TECHNICAL PROGRAMME

In 1993 the Flight Mechanics Panel will hold two Symposia, and form one new Working Group, and with two other Working Groups completing their meeting schedule during the year. Work on two new AGARDographs will commence, with preparation work on eleven other AGARDographs continuing, of which five will be published during the year. Support Projects to Greece and Turkey will continue.

#### MEETINGS

Spring Symposium, The Netherlands, May 1993:

##### **Recent Advances in the Long Distance and Long Endurance Operation of Aircraft**

For many years, the use of aircraft in long range and/or long endurance operations has proved to be an important use of military resources. Operations such as tactical strikes mounted from bases thousands of miles away, to the use of long endurance patrol aircraft over either the battlefield or maritime environment demonstrate the ability now contained in the NATO operational forces. The use of military airlift to position forces where they are most needed is another operation where the range and endurance of the aircraft are pivotal to the success of the mission.

Technologies which improve the range and endurance of aircraft have seen considerable advances over the past ten years. Aircraft design in this area has matured considerably while the procedure of air-to-air refuelling has made global deployment and twenty-four hour operations a reality. While not generally perceived as long range aircraft, the range and endurance of fighters (both subsonically and supersonically), V/STOL aircraft and even rotorcraft have improved considerably over the last generation of vehicle design.

With the current perceived requirements to fly further, faster and longer, this symposium will summarize the latest technological advances in the various fields which in a combined manner define the range and endurance of airborne vehicles. The future trend in the relevant technologies, and the way in which improvements might be utilised will be considered. Since the operation of air-to-air refuelling can significantly change the range and endurance of vehicles, it will receive special attention in the course of the symposium.

The symposium (about 25-30 papers) will be structured around four sessions with a positive involvement sought from other Panels.

The sessions will cover the areas of:-

- (a) Airframe Design for Long Range & Endurance

This session will endeavour to describe the more important advances in the fields of aircraft weight and drag reduction. Some of the topics in this session are: optimization of the airframe configuration for high cruise efficiency, structural techniques to increase the payload weight fraction of aircraft, the weight savings provided by non-conventional (i.e. "not aluminum") airframe structures, techniques to improve the boundary layer 'character' on airframes in the cruise configuration, and advances in the design and carriage of aircraft stores.

(b) Propulsion System Optimisation

The objective of this session should be to highlight those advances in engine technology which most significantly effect the aircraft range and endurance. Topics for papers could include: techniques to more efficiently integrate propulsion systems in the airframe, advances in aircraft technologies which directly improve engine efficiency (i.e. materials that withstand higher temperatures etc.), the tradeoff between pure performance requirements and cruise efficiencies (the multiple design point problem), consideration of problems caused by longer flight times (i.e. cooling, lubrication), and fuel choices to enhance range and endurance and the associated tradeoffs.

(c) The Human Factors Aspects

The tradeoff between aircrew combat-readiness and the length of extended transit to and from the zone of operations must be clearly understood in order to enable the best tactical choices when long range missions are contemplated. Topics for this session could include: the aircrew performance implications of extended operation times, airframe design features which limit the aircrew performance degradation, cockpit and cockpit systems design with aircrew fatigue in mind.

(d) Air-to-Air Refuelling

The use of air-to-air refuelling allows the range and endurance of any airframe to become almost limitless. The use of this technique does impose significant technological difficulties however. The objective of this session should be two-fold: it should address both the operational requirements imposed by the task and the design tradeoffs made to make an airframe air-to-air "refuelable". Topics for papers in this session could include: design studies of aircraft for modification to allow air-to-air refuelling, the trade-offs between different air-to-air refuelling methods (controlled pod versus drogue and boom), the techniques of receiver-tanker rendezvous and tanker protection, design of airframes as tanker aircraft, other techniques to increase vehicle effective range, such as forward staging bases.

This programme would involve a high degree of interpanel cooperation, with papers and, where appropriate, Session Chairmen being sought from FDP, SMP, PEP and AMP.

Fall Symposium, USA, October 1993:

### Technologies for Highly-Manoeuverable Aircraft

The new generation of combat aircraft under development does not extend significantly the flight envelope in terms of Mach number or altitude, but provides within it, much greater manoeuver capabilities, which are essential to survival and favourable exchange ratios in future scenarios. The aim of the symposium is to review the various technologies that can be used to achieve high manoeuverability, as well as the techniques used to overcome the design problems they pose. The symposium will follow a layout of 24-26 papers in five sessions concerned with supersonic manoeuver, thrust-vectoring in flight, post-stall control, handling qualities problems relevant to these flight regimes and the tools used to mitigate them, and finally a review of current demonstrator and development programmes embodying these technologies.

A keynote paper will present an overview of why manoeuverability is important to combat success, and perhaps quantify the relative benefits of various levels of manoeuverability in different flight regimes. The concept of agility will be introduced.

- (a) SESSION I 'SUPERSONIC MANOEUVER' will cover the aerodynamic and propulsion requirements for sustained supersonic manoeuvres, as well as the advantages of extending the high-g envelope beyond the transonic regime and its implications on overall design.
- (b) SESSION II 'THRUST VECTORING IN FLIGHT' will cover the utility of thrust vectoring for manoeuver enhancement, precise flight path control for minimizing touchdown dispersion and landing rollout, improved takeoff performance, or other tactical purposes.
- (c) SESSION III 'POST STALL FLIGHT' will consider the extension of the flight envelope into the post-stall regime under the headings: tactical advantages, available techniques, and implications in overall design.
- (d) SESSION IV 'HANDLING QUALITIES AND SIMULATION' will examine the difficult design challenges in the area of handling qualities resulting from the use of advanced technologies to achieve this high manoeuverability, aggravated by the fact that simulation may also not be easy. The extent to which these problems can be tackled by existing design and simulation methods (including computational fluid dynamics, wind tunnel testing, pilot-in-the-loop simulators, ground test rigs, etc) would be discussed.
- (e) SESSION V 'DEMONSTRATOR AND DEVELOPMENT PROGRAMMES' will review those current demonstrator aircraft and development programmes which include the achievement of high levels of manoeuver performance in order to indicate available experience and how the various challenges are being tackled.

This programme is seen as needing strong support from other Panels such as FDP, SMP and PEP.

**SHORT COURSE**

It is envisaged that the course on 'Flight Test Instrumentation', organised jointly with the College of Aeronautics, Cranfield (UK), will again be held in Spring 1993 at Cranfield.

The aim of this course is to provide a sound introduction to the theory and practical application of flight test instrumentation techniques. The lectures will be strongly supported with practical demonstrations and case studies of actual instrumentation installations. A comprehensive set of course notes will be provided.

**WORKING GROUPS**

Working Group 19:

**Operational Agility**

This group will complete its schedule of meetings in Fall 1992 and should issue a full report in 1994. It is expected that a preliminary report will be passed to AAS 34 in Spring 92.

Working Group 20:

**Piloted Simulation in Low Level High Speed Mission Rehearsal**

This group will complete its schedule of meetings in Spring 1993 and should issue a preliminary report to AAS-34 at that time, with a full report in 1994.

Working Group 21:

**Glass Cockpit Operational Effectiveness**

This Working Group is a new proposal and will start work in Spring 93, with a normal two year period of operation. The proposed Working Group will perform a critical review of "glass cockpit" technologies, and will create a document which describes the current "state of the art" in this technology, highlights the benefits and weaknesses of current glass cockpit subsystems and provides a summary of user experience to allow informed design decisions for the glass cockpits designs of the future. While electronic multi-function displays can be found in a variety of military and civil aircraft, the Working Group will probably limit its considerations to those found in single and two pilot combat aircraft since these cases probably represent the uses where the demands on the pilot and crew are the most severe.

**AGARDOGRAPHS**

New AGARDographs to be commenced in 1993:

**\*Stick and Feel System Design**

A wide variety of pilot inceptor designs and their associated feel systems have been derived over the years, covering all classes of aircraft, including helicopters and V-STOL, to spacecraft, such as the Shuttle. With each class of design of aircraft, there have been different inceptor systems, some being notable successes, others being catastrophic. A range of experiments have been performed to try and identify what makes for good and bad systems; some of these have been completed in the recent past, but the results have not in general been drawn together or digested into comprehensive and comprehensible design guidelines. This AGARDograph will collect together the experience of stick and feel system designs from within the aeronautical community, with a view to collating and digesting the information into a form suitable for future use by designers.

**\*Simulation of Aircraft Handling on the Ground**

In 1985 an AGARDograph (No. 285) was published on this subject and has been an important reference document. Since that time there has been a significant increase in information on the behaviour of tyres and brakes, the characteristics of surfaces and the effects of contamination (rain, ice and snow).

There is also an increasing need to demonstrate and evaluate military and civil project performance from a wide variety of operating sites in addition to normal airfields. Further, there are a wide range of project proposals involving novel features such as active suspension, unusual undercarriage geometry, new braking systems, etc.

Finally, simulation capabilities in computing capacity and cueing from visual scenes and motion systems have improved dramatically.

It is proposed that the authors of AGARDograph 285 produce a further AGARDograph on this subject. This will extend the earlier information to include the new knowledge, and present techniques to enable appropriate representation of new design proposals.

**SUPPORT PROGRAMME**

Support will continue to be given to Greece, Portugal and Turkey. The major support projects during this year being G74 "Flight Testing of RPVs" which is supported by the USA, and T77 "Estimation of Errors in Aerodynamic Coefficients of a Missile, and the effect on the design of the Missile Flight Control System", which is supported by Spain.

\*subject to funds being made available

PUBLICATIONS

**Recent Advances in Long Distance/Long Endurance Operations**  
Conference Proceedings, June 1993

**Technologies for Highly Manoeuvrable Aircraft**  
Conference Proceedings, November 1993

**Operational Agility**  
Advisory Report, June 1993

**Identification of Dynamic Systems,  
Application to Aircraft -  
Part 2**  
**Non Linear Model Analysis and  
Manoeuvre Design**  
AGARDograph, October 1993

**Terrain Following  
Flight Testing**  
AGARDograph, December 1993

**Reliability and Maintainability Testing**  
AGARDograph, December 1993

**Testing of Flight Critical Systems  
on Helicopters**  
AGARDograph, December 1993

**Flight Testing of Air to Air Refuelling of  
Fixed Wing Aircraft**  
AGARDograph, December 1993

## Fluid Dynamics Panel

**CHAIRMAN:** Prof. Ir. J.W. SLOOFF, Netherlands  
**DEPUTY CHAIRMAN:** Mr. C. DUJARRIC, France  
**EXECUTIVE:** Dr. W.D. GOODRICH, United States

### 1993 TECHNICAL PROGRAM

The Fluid Dynamics Panel will organize and conduct two Symposia, two Special Courses, and a Short Course; will form a new Working Group; will initiate a new AGARDograph; and will complete seven AGARD Publication during 1993.

Several new Support Projects will be initiated under the Support Program to the Southern Flank Nations as other existing Projects are successfully concluded.

The established tradition of actively participating in the Technical Programs of the other Panels to enhance cooperation and effectively utilize available resources will continue.

### MEETINGS

Spring Symposium - United Kingdom - April 1993:

#### **Computational and Experimental Assessment of Jets in Cross Flow**

Many aerospace systems utilize jets-in-cross-flow technology to provide a broad array of performance enhancement functions. Specifically, the technology provides important functions in VTOL and VSTOL applications, high angle-of-attack maneuvering, and aircraft control. In addition, important propulsion applications arise in the context of turbine blade cooling and supersonic fuel injection and combustion.

The purpose of this Symposium is to provide a forum for reporting on recent progress and plans from programs aimed at developing this technology for aerospace applications. The scope will include computational and experimental analyses of jets in cross flows at both subsonic and supersonic conditions. Papers dealing with 2D and 3D problems for laminar and turbulent flows will be considered. Buoyancy driven jets or plumes will not be considered within the scope of the meeting.

Fall Symposium - Belgium - October 1993:

#### **Wall Interference, Support Interference, and Flow Field Measurements**

Wind tunnel tests continue to provide the primary sources of data for predicting aerodynamic structural loads and forces and moments for aerospace vehicle design and performance assessment. However, data errors and uncertainties can lead to large penalties in design and performance margins for these vehicles. To help avoid this, wind tunnel testing technology is emerging which is aimed at providing data that is essentially free of errors caused by flow field interference from wind tunnel walls, model support structures, and intrusive flow field measurement devices.

To this end, the purpose of this Symposium is to report on recent developments from research and technology programs aimed at reducing test data errors caused by wind tunnel walls, model supports, and intrusive flow field measurement devices. The scope will include wall interference correction methods based on measured data at the walls and methods to eliminate wall interference through adaptive and/or ventilated walls. Support interference topics will include recent empirical correlations as well as magnetic suspension results. Advancements in flow field visualization techniques and local flow field measurement techniques will also be included. The speed regimes will include subsonic, transonic, and low supersonic flows.

#### SPECIAL AND SHORT COURSES

Special Course No. 1 - Belgium and Greece - Spring 1993:

##### **Shock-Wave/Boundary-Layer Interaction in Supersonic and Hypersonic Flows**

Several recent studies of advanced launch vehicles and high speed transport aircraft have resulted in candidate configurations which produce complex flow fields with shocks that interact with the vehicle boundary layer while flying at both supersonic and hypersonic speeds (e.g., NASP, SANGER, ALS, SST-II, etc.). Ongoing technology programs aimed at addressing shock-wave/boundary-layer interaction problems at these speeds have resulted in new information of interest to the designer. Specifically, new tools based on experimental results and Computational Fluid Dynamics (CFD) analysis have been developed to help address issues relating to structural loads, aerodynamic forces and moments, and heat transfer rates caused by shock-wave/boundary-layer interactions.

The course will include recent information from experimental and CFD studies conducted at some of the leading research facilities within NATO. An overview of this research and a description of the flow field phenomena associated with shock-wave/boundary-layer interactions--for both laminar and turbulent boundary layers--will be presented to help orient the student. In addition, flow field unsteadiness caused during these interactions will be addressed. Tools for analyzing 2D and 3D interactions will be described.

Special Course No. 2 - Spain and Belgium - Spring 1993:

##### **Progress in Transition Modelling**

Aerospace vehicle design decisions and performance assessments are frequently tied to predictions of both skin friction drag and pressure drag associated with boundary layer separation. These predictions of drag are, in essence, related to the state of the boundary layer--laminar or turbulent--and when this transition in state occurs during flight.

An essential part of predicting transition is the understanding of the different mechanisms that drive the dynamics of transition to turbulence. The purpose of this course is to tie together recent developments from courses, symposia, workshops, etc. into a coherent package that can be of use to the designer. The scope will cover new developments in modelling the dynamics of transition to turbulence. Approaches to be presented will include Parabolized Navier-Stokes

solutions, Direct Navier-Stokes simulations, k-epsilon closure models, analytical and empirical methods, and nonlinear dynamical systems.

Short Course - Turkey, Italy, and the United Kingdom - Spring 1993:

**Aerodynamics of Manoeuvring Aircraft**

Continued progress in the development of highly agile aircraft will require continued progress in the understanding of the separated, unsteady flows associated with these vehicles. The aerodynamic force and moment inputs necessary for design will, to a large degree, be provided by suitable dynamic experiments in wind tunnels. Such experiments must encompass both oscillatory and rotary techniques capable of testing at extreme attitudes and/or high-angular-rate motions.

This FDP Short Course will be based on the successful FDP Special Course on "Aircraft Dynamics at High Angles of Attack: Experiments and Modelling" that was held in the United States and Belgium in 1991 and on the 1990 report of FDP Working Group 11 on "Rotary-Balance Testing for Aircraft Dynamics". During this course, requests were made to repeat a condensed and updated version in several additional countries. The short course will address flight and manoeuvres at high angles of attack, unsteady and non-linear aerodynamics, manipulation of vortices, enhanced aerodynamic control at high alpha, relevant experimental and computational techniques, and the modelling of aircraft behavior. Reprints of the previous Special Course Notes (AGARD R-776) and the final report of WG11 (AR-265) will be used as reference material for this short course.

**WORKING GROUPS**

During 1991, FDP Working Group 13 on "Air Intakes for High Speed Vehicles" successfully completed its activities and the publication of its final report (AGARD AR-270). Also, three new Working Groups were initiated in 1991 and two new Working Groups were approved in 1991 to start in 1992, for a total of five FDP Working Groups. Using the revised definition (from the spring 1992 NDB Meeting) of when a Working Group can be considered inactive--a Working Group is considered inactive when its final report is submitted to AGARD; versus, when the final Working Group meeting is held--the commencement and completion dates, along with the status of these Working Groups, are presented below:

**WG14 on Selection of Test Cases for CFD Validation (1990-93)**

WG14 has completed four meetings (Amsterdam, September 1990; Toulouse, April 1991; Washington DC, October 1991; and Pisa, May 1992) and is making good progress. Plans are to hold the next meeting in Banff in October 1992 and the final meeting in the UK in April 1993. The final report will be submitted in the summer of 1993.

**WG15 on Quality Assessment of Wind-Tunnel Testing (1990-92)**

Two meetings have been held (Toulouse, April 1991 and Tullahoma, October 1991) and excellent progress has occurred. Plans are to edit the final report at the last meeting to be held in October 1992. The final report will be provided to AGARD in November 1992.

**WG16 on Cooperative Program on Rotary Experiments for Manoeuvring Aircraft Dynamics (1991-95)**

Two meetings have been held (Ottawa, March 1991 and Paris, May 1992) and progress is being made with the test program and subgroup activities associated with this four year program. The third and fourth meetings are expected to be held in the UK in 1993 and Greece in 1994. The final meeting will be in the spring of 1995, which will be followed by the submission of the final report in the summer.

**WG17 on Aerodynamics of 3-D Aircraft Afterbodies (1992-95)**

In compliance with the ceiling on the number of active AGARD Working Groups, formation of WG17 was delayed until 1992. The first meeting will be held in Banff in October 1992. It is expected that two meetings a year will occur in 1993 and 1994. The final meeting will be in the spring of 1995, which will be followed by the submission of the final report in the summer.

**WG18 on Hypersonic Experimental and Computational Capabilities- Improvement and Validation (1991-94-96)**

In the two meetings held to date (NASA Ames, December 1991 and Toulouse, May 1992) plans and commitments have been finalized which point to the need for a more comprehensive program of work to be conducted in two Phases. To this end, a proposal will be drafted for a 2-year extension of the WG18 activities. In essence, the Working Group will address the items described in its initial proposal in a Phase I program and the newly identified items in a Phase II program.

The Phase I program will require the original schedule of meetings (two a year through 1993). A final WG18 report on Phase I will be submitted to AGARD in the spring of 1994.

The Phase II program will address a more extensive cooperative experimental program which will develop key data--for facility calibratior and CFD code validation activities--from most of NATO's premier hypersonic test facilities. Plans are to conclude this program with a Workshop in the fall of 1995 and to produce both a Workshop report and a final WG18 report on Phase II in the spring of 1996.

Through this comprehensive two Phase program, the outlook is promising for developing and providing a documented international perspective on the requirements for and status of hypersonic experimental and CFD flow field simulation capabilities.

By the end of 1993, the FDP will have only three active Working Groups (WG16, WG17, and WG18). To complement these remaining activities and to fulfill the near-term interests of the Panel, the following new Working Group is proposed for 1993:

**WG19 on Sonic Nozzles for Mass Flow Measurement and Thrust Calibration (1993-96)**

Thrust measurement of engine nozzle models and thrust calibration of engine simulators used on aircraft models to study engine installation drag in wind tunnel testing are based on mass flow measurements by sonic nozzles and on thrust measurements of reference sonic nozzles. The objective of this Working Group is to

provide a better assessment of these mass flow and thrust measurements with the goal of providing engine simulator thrust data that are consistent with the data accuracy needed for wind tunnel testing and for flight predictions.

**AGARDOGRAPHS**

The Panel will sponsor one new AGARDograph to start in 1993:

**Reynolds Number and Mach Number Effects on Boundary Layer Structure**

This will be a collaborative, experimental study conducted in Germany, France, and the United States which will investigate the effects of Reynolds number and Mach number on the structure of turbulent boundary layers for flat plates with zero pressure gradients. Measurements will provide a detailed documentation of the structure of the boundary layer for use in evaluating turbulence models derived from low Reynolds number flows. The AGARDograph will be published in 1995.

Work on two previously approved AGARDographs is progressing and publication of both of these is scheduled for 1993.

**SUPPORT PROGRAM**

Several new Support Projects will be implemented to replace others that will be successfully concluded. An FDP Support Projects Committee reviews all new project proposals to ensure that they are technically sound with clear objectives and goals. In 1993, a total of seven Support Projects is expected to be underway.

**PUBLICATIONS**

The following items are planned for publication in 1993:

**High-Lift System Aerodynamics**

F92 Conference Proceedings (CP-515), January 1993

**Shock-Wave/Boundary-Layer Interaction in Supersonic/Hypersonic Flows**

Special Course Notes (R-792), February 1993

**Progress in Transition Modelling**

Special Course Notes (R-793), February 1993

**Selection of Test Cases for CFD Validation**

Working Group 14 Report (AR-303), February 1993

**Scale Effects on Aircraft and Weapon Aerodynamics**

AGARDograph (AG-323), June 1993

**Computational Aerodynamics Using the Euler Equations**

AGARDograph (AG-325), June 1993

**Computational and Experimental Assessment of Jets in Cross Flow**

S93 Conference Proceedings (CP-534), October 1993

## **Guidance and Control Panel**

Chairman : Dr E B STEAR, United States  
Deputy Chairman : Mr S LEEK, United Kingdom  
Executive : Commandant M MOUHAMAD, FAF

### **1993 TECHNICAL PROGRAMME**

The Technical Programme proposed for 1993 by the Guidance and Control Panel consists of two Symposia, one Lecture Series, the extension of one Working Group and one AGARDograph.

#### **MEETINGS**

Spring Guidance and Control Panel 56th Symposium, Berlin, May 1993:

##### **Machine intelligence in air traffic management.**

Over the past 20 years, the Guidance and Control Panel has devoted part of its activities to the fascinating field known historically as Air Traffic Control, covering both civil and military domains. This vast discipline includes a variety of control loops each being characterized by a specific look-ahead time.

It is proposed to organize a GCP-Symposium placing the emphasis on the potential use of "Machine Intelligence" in the overall control loop covering all sub-loops - management, flow management, control, guidance, conflict alert and collision avoidance - and assessing the benefits which should or might result for the aviation community - designers and users.

Airspace congestion is a reality and, whatever the causes, the resulting problems are known only too well. And yet, demand continues to grow. Forecasting experts agree that traffic densities will double in 10 to 15 years time. Others envisage, in the slightly longer term, the bringing into service of supersonic aircraft cruising at Mach 3 and even hypersonic speeds.

In today's chain of control it is the human link, i.e the controller, who is sovereign. He is in a sense an artist dealing with situations on a case-by-case basis, drawing on his talent, intuition, experience and judgement.

These are all inputs which are difficult for him to get across to us and which are hard for us to put in a form which can be expressed mathematically.

The arrival of state-of-the-art technologies has opened up new visions revealing ways of rolling back the present day limitations of the ATC system, namely the restricted runway or en route capacity and the rapid saturation of the human controller's ability to handle data.

Thanks to this technological potential, we are now able to envisage the acquisition, enhancement and exploitation of knowledge bases together with the use of automated digital data links for one-way or two-way ground-air data exchange which would then be able to extend far beyond current applications and encompass an extremely wide range of information.

In order to set up a new and efficient system in which there is harmonious integration between modern technologies and human abilities, close cooperation between the ground component designers and those responsible for the air component is essential. More particularly, the latter must ensure that there is efficient collaboration involving controllers, who alone are capable of transferring their art, albeit only in part, to highly automated aids.

The Symposium will emphasise this twofold cooperation: firstly, between the ground and air components; secondly, cooperation between those setting up and using the ATC system, controllers, pilots, psycho-metricians, engineers and ... passengers.

Further, in a general framework and spirit of cooperation, special invitations will be addressed to military representatives (NATO and National Authorities) to cover specific military applications for which a high level of automation is required or highly advisable.

The following topics are to be covered:

- Air Traffic Management Systems and Sub-Systems
  - . Large scale
  - . Chaotic
  - . Stochastic
- Present situation
  - . Analysis of ATM progress
  - . Airport congestion
  - . En-route saturation in critical areas
  - . Limitation of controller's handling capability
  - . Weather constraints
  - . Results:
    - Increasing delays
    - Economy penalties
    - Passengers and crews complaints
    - Difficulties of introducing automation
    - Objectives
  - . Expectation of air traffic growth (to meet)
  - . Increase use of available capacity
  - . Meeting future social mandate
  - . Need of machine intelligence as a support to the controller.
- Potential of research and development programmes
  - . International and national programmes
- Resulting new guidance and control functions
  - . Short/medium/long term planning
  - . Integration of control phases (ground movements included)
  - . Diagnosis: conflicts, workload, capacity...
  - . Decision supports
- Future role of the man-in-the-control-loop
  - . Social aspects
- Onboard - on the ground
- Current practice - critical solutions
  - . Performance and limitations
  - . Automation assistance for decision making

- A case for cooperation
- Recommendations/conclusions

Fall Guidance and Control Panel 57th Symposium, Seattle, October 1993:

**Pointing and tracking systems.**

Pointing and tracking systems form the core elements of the majority of gun fire control and surveillance and tracking sensors. In many cases the requirements of hit-to-kill weapons and extremely long-range EO imaging and tracking systems require pointing accuracies measured in micro-radians. Maintaining such precision in optical systems has introduced the need for adaptive optics and highly stabilized mechanical mounts and actuators. In terms of man-in-the-loop weapon systems, the use of head mounted systems for designation of targets requires tracking systems for the helmet in a cockpit. Of increased importance is the fusion of sensors to provide a tracking solution for low-observable targets. As a result of the above, a symposium in Pointing and Tracking will cover a wide area of G & C activities. The symposium will concentrate on the pointing and tracking issues in the following sessions:

- Overview of P & T systems
  - . Space
  - . Aircraft
  - . Ship & Submarine
  - . Land
- Optical P & T systems
  - . Active systems (e.g. lasers)
  - . Passive systems (e.g. TV, IRST)
  - . Adaptive optics
- Mechanical systems
  - . guns, missiles, radars
- Helmet tracking systems
- Pointing and tracking components
  - . Pickups
  - . Motors/Actuators
  - . Optical components
  - . Dedicated electronic components
  - . Inertial elements
- Algorithms for P & T
  - . Tracking algorithms for EO, radar, sonar & mechanical systems
  - . Control algorithms
  - . Stability considerations
- Sensor fusion for P & T
  - . Common & distributed apertures
  - . Fusion of EO/radar/EW sensors

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**LECTURE SERIES**

The Panel proposes to sponsor one Lecture Series:

**Non linear dynamics and chaos**

**WORKING GROUP**

The extension of WG.11 on **Knowledge based guidance and control functions** is requested until Spring 1993.

**AGARDOGRAPH**

One AGARDograph on **Computer aided design and simulation\*** will be prepared in 1993.

**PUBLICATIONS**

**Aerospace navigation systems**  
AGARDograph, January 1993

**Non linear dynamics and chaos**  
Lecture Series, March 1993

**Machine intelligence in air traffic management**  
Conference Proceedings, July 1993

**Knowledge based guidance and control functions**  
Advisory Report, October 1993

**Pointing and tracking systems**  
Conference Proceedings, December 1993

**\*Computer aided system design and simulation**  
AGARDograph, December 1993

## Propulsion and Energetics Panel

Chairman : Prof. Dr. A. ÜÇER, Turkey  
Deputy Chairman: Mr. R.E. HENDERSON, USA  
Executive : Dr. E. RIESTER, Germany

### 1993 TECHNICAL PROGRAMME

The Propulsion and Energetics Panel will hold two Symposia and provide a Lecture Series at three locations.

One existing Working Group will continue and one extended Working Group will finish in 1993.

The results of Working Groups 20 and 23 will be published in 1993.

As usual the Panel will continue to contribute to activities of other Panels and to sponsor Support Programs to Greece, Portugal and Turkey.

### MEETINGS

May 1993, Italy

#### Fuels and Combustion Technology for Advanced Aircraft Engines

New interests and requirements for engine performance, efficiency, and environmental concerns have generated new areas of combustion research since the last PEP Symposium on the topic of Fuels and Combustion for Gas Turbine Engines in Fall 1987. Advanced high-pressure/high-temperature cycle engines result in unique problems in ignition and altitude relight, cooling, and fuel systems. New technologies in low-NO<sub>x</sub> burners are also needed. Also there have been significant advances in combustion modelling and diagnostics to aid the development of these new technologies.

The Symposium overviews will address the advanced aircraft propulsion technology requirements in high-pressure/high-temperature cycles and for supersonic cruise, and will also include a paper on the atmospheric response to exhaust emissions. Separate sessions will be devoted to the following:

- . fuel technology and fuel systems for advanced engines
- . combustion research
- . application and verification of models
- . instrumentation and diagnostics

Individual topics of particular interest to be covered in these sessions are performance, fuel/air mixing, ignition, formation and control of emissions, soot formation and radiation, flow visualization, and measurements of processes involved. Papers on modelling will stress verification and application to design. Results from combustor experiments on fuel injection and mixing, ignition and stabilization, and staged combustion for emissions control along with advances in fuel technology such as improved thermal stability will provide an overview of the state of art and advances to be expected in the near future.

October 1993, Canada

### **Technology Requirements for Small Gas Turbines**

In general the small engine field is currently undergoing a second generation of designs in all aspects, turboshaft, turboprop and turbofan plus auxiliary power units with several manufacturers. Several technical developments are driving this such as: improved aerodynamics, new increased strength and temperature materials, four dimensional stress analysis, a better understanding of material properties and improved heat transfer which all lead to increased cycle pressure ratio and temperature at high speeds. The resulting reductions in fuel consumption, weight and cost coincide with corresponding improvements in airframes.

In addition increasingly severe environmental requirements are forcing significant improvements in combustors, acoustics and aerodynamics.

The advent of a series of new engines and technologies provides the opportunity to share these developments through the AGARD community and assist the application of the best technologies in these new products.

The symposium will be devoted to a general review of both civil and military small gas turbine technology requirements up to 5000 HP (7,000 lb) thrust. The primary aspects of mechanical and aerodynamic design, environmental (emissions and noise) impact, secondary air systems, auxiliary power systems and advanced engine designs will be covered in the general concepts, while avoiding detailed aerodynamic and structural analysis methods. The sessions will not be limited to propulsion but will also extend to stationary and closed cycle applications. Topics including analysis and testing as well as service experience and design implications and requirements will provide a wide interest span for participants.

### **LECTURE SERIES**

June 1993, Germany, UK and US:

#### **Rocket Motor Plume Technology**

Requirements for missile guidance and stealth properties are changing and becoming more stringent. Events in the Middle East early 1991 have demonstrated this very drastically. As there seems to be no up-to-date synthesis of the question of rocket motor plume properties related to these new requirements, this Lecture Series will be a very good way to give the nations' experts access to the work recently performed by PEP Working Group 21 imbedded in a broader context. The scope of this Lecture Series will be rocket motor exhaust products and plumes in all their aspects. The description, numerical simulation and assessment of plume properties will be addressed.

More specifically plume structure, primary smoke, secondary smoke, after-burning phenomena, plume radiation and plume microwave properties will be described in detail.

The operational aspects linked to these phenomena will be addressed as well as the influence of related missiles and system requirements.

#### **WORKING GROUPS**

**Working Group 22:**

##### **Ramjet Performance Determination**

Working Group 22 held its fourth plenary meeting in Bonn in Fall 1991 and will extend its work to the end of 1993.

**Working Group 23:**

##### **Transient Measurements in Gas Turbines**

Working Group 23 had its fourth plenary meeting also in Bonn in Fall 1991. It plans to hold its last meeting in Fall 1992 and to publish its work in the form of a "Users' Guide" in 1993.

**Working Group 24:**

##### **Humidity Effects in Gas Turbines**

Working Group 24 will have its first plenary sessions in 1992 and will continue to meet until 1994.

#### **AGARDOGRAPHS**

**To be published in 1993:**

##### **Test Cases for the Application of Engine Life Assessment Technology**

This AGARDograph will document the results of Working Group 20. The events in the Middle East early 1991 have delayed its completion.

#### **SUPPORT PROGRAMME**

Support will continue to be given to Greece, Portugal and Turkey as the nations concerned approve requests for suitable projects received, reviewed and endorsed by the Panel.

#### **RELATIONS WITH NATO**

The results of Working Group 21 on "Terminology and Assessment Methods of Solid Propellant Rocket Exhaust Signature", which are expected to be published in 1992 as Advisory Report AR 327, are considered to be a worthwhile proposal for a new propellant smoke classification to be adopted throughout NATO. The Panel will continue discussing this matter with the Military Agency for Standardization (MAS) operating under the NATO Military Committee as soon as the report is available in printing.

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The NATO Pipeline Committee, acting on behalf of the NATO Council has requested for the benefit of its Working Group 04 on "Fuels and Equipment Inter-operability" the assistance of AGARD. PEP has agreed to sponsor and lead a small study group investigating the technical operational implications of changing from Jet A-1 fuel to Jet A fuel in NATO. The findings are due to be reported to NATO in Fall 1993.

**PUBLICATIONS**

**Heat Transfer and Cooling in Gas Turbines**  
Conference Proceedings, April 1993

**Rocket Motor Plume Technology**  
Lecture Series Notes, June 1993

**Test Cases for the Application of Engine Life Assessment Technology**  
AGARDograph, July 1993

**Transient Measurements in Gas Turbines**  
Advisory Report, July 1993

**Fuels and Combustion Technology for Advanced Aircraft Engines**  
Conference Proceedings, September 1993

## **Structures and Materials Panel**

Chairman : Mr S.L. VENNERI, US  
Deputy Chairman : Mr R. LABOURDETTE, FR  
Executive : Dr J. M. CARBALLAL, SP

### **1993 PROGRAMME**

The Structures and Materials Panel will organise and conduct four Workshops.

Several new Support Projects are under consideration by the Panel to replace those Projects terminating in 1992. A number of publications will be produced in 1993 to record the activities of the Panel. The Panel will maintain its strong interaction with the other AGARD Technical Panels.

### **MEETINGS**

Spring Panel Meeting, Turkey

A two day Workshop will be held on:

#### **Introduction of Ceramics into Aerospace Structural Composites**

New families of brittle-matrix composites are potential competitors to conventional and other developmental materials for applications ranging from relatively mild to the highest current materials temperatures. Furthermore, they offer potential dramatic increases in application temperature with associated increases in heat-engine efficiency and performance. The materials range from carbon reinforced glasses which might compete with titanium alloys, intermetallics, and lower temperature applications of nickel based alloys to future oxide-oxide composites which would replace superalloys and refractory metals in most of the highest temperature applications.

There are numerous issues that may delay the application of ceramic matrix composites (CMC) in high temperature structural applications. Current processes are neither controllable nor reliable. Mechanical properties, in turn, may be strongly affected by the process parameters. Thus there is a need for the process science and manufacturing science research, and ultimately, manufacturing technology R&D for complex shapes.

Despite their problems CMC have strong interest and may represent the materials of the future for high temperature applications related to vehicles and/or weapons.

This Workshop will review, assess, summarize, and widely distribute the latest state-of-the-art developments in research on CMC regarding their basic behavior, modeling, and contemporary usage in structural components. To attempt to establish one or more key

issues to focus upon to provide a convenient and productive mechanism for cooperative research. Such topics may involve basic failure modes, macro- or micro-testing procedures, interface mechanisms, or windows of opportunity for specific material systems.

The second Workshop will also be 2 days in duration on:

**Integrated Airframe Design Technology**

This Workshop will be the first of two Workshops (the second will be conducted in 1994). It is recognized that the rapid evolution of computer hardware that includes powerful workstation concepts to super computers has opened up new opportunities for solving more complex and larger structural design problems. This future direction provides the ability to develop and incorporate a new design methodology from conceptual to final detailed design verification including the integration of design concepts with efficient interdisciplinary optimization and the capability to evaluate cost effective manufacturing processes. This approach will expand the scope of the engineering process for aerospace vehicle design and provide the ability to understand and utilize high-performance new material systems and develop novel structural concepts.

Computational technology will play a significant role in the development and certification of future flight vehicles. A critical element for new systems is to predict response, performance, failure and the life of flight vehicle structures at operating conditions. The understanding of manufacturing costs on design tradeoffs is critical to balance performance against life cycle operational costs.

This activity will provide a broad-based approach to evaluate and recommend future R&D directions in integrated airframe design technology. This activity will look toward the future in computational needs for structures technology considering the direction in the high-performance computing environment. Specifically, the evaluation of computational strategies for large-scale problems will include:

- Local/Global Analysis Methods
- Interdisciplinary Design, Analysis and Optimization
- Probabilistic versus Deterministic Structural Design
- Computational Materials Modeling
- Manufacturing Cost Models and Integration into the Design Process
- Future Computational Hardware Environment and Impact on Integrated Design
- Information Transfer - Networking

Fall Panel Meeting, France

A two and a half day Workshop will be held on:

**An Assessment of Fatigue Damage and Crack Growth Prediction Techniques**

There is a need to review techniques available for the prediction of fatigue damage accumulation and crack growth. Not only are such methods essential at the airframe design stage but they are also fundamental to the fatigue monitoring process which is essential to the maintenance of structural integrity.

Some methods are independent of applied load sequence whereas others take account of previous history. In the fatigue monitoring role it is necessary to address:

- (i) The way in which cycles are identified
- (ii) The methods for assessing the accumulation of fatigue damage and crack growth.

Both of these inter-relate with the fatigue test and provide the means of establishing the severity of service flying.

The continuing need to maintain the NATO fleet of aircraft for increasing lives requires an accurate assessment of usage to be made relative to that demonstrated on the fatigue test. There is a fundamental reliance placed on the techniques used for cycle identification and fatigue damage or crack growth accumulation.

The objectives of the study are to make recommendations on:

- (i) Methods for cycle identification
- (ii) Methods for fatigue damage assessment
- (iii) Methods for crack growth assessment

A second Workshop lasting two days will be held on:

**Characterization of Fibre Reinforced Titanium Metal Matrix Composites (MMCs)**

Fibre reinforced Titanium MMCs offer improvements in structural stiffness, strength and/or crack growth characteristics. These improvements are of major benefit to both airframe and engine applications. Among the most difficult tasks facing a designer in these materials are:

- a. Establishment of the properties of the material by specimen testing
- b. Relationship of these properties to full scale component testing
- c. Assessment of component integrity.

Internationally, there is very little information available and no consensus on the correct approach to take in both testing of, and designing with these materials.

Fibre reinforced Titanium MMCs are seen as low manufacturing volume, high cost materials of specific interest for high technology aerospace applications. The development of these materials is crucial to the achievement of projected performance requirements for military hardware in the 21st century. This is true, for example, for high thrust/weight ratio engines and for enhanced manoeuvrability combat aircraft, which will be required by all NATO nations. Given the limited applications of these materials in areas other than aerospace, AGARD is seen as a natural forum for the initiation of discussions and information exchange on test requirements and techniques.

The following specific topics will be addressed:

- Review test methods for material characterization
- Establish the relationship between test properties and material behaviour within the component.

#### **LECTURE SERIES**

May Lecture Series 190, TU, GR, PO, CA

#### **A Recommended Methodology for Quantifying Non-Destructive Inspection and Evaluation (NDI/NDE) Based on Aircraft Engine Experience**

This Series is the follow-on to the Specialists' Meeting on "Impact of Emerging NDI/NDE Methods in Aircraft Design Manufacture and Maintenance" held at the 69th Meeting of the Structures and Materials Panel in Brussels.

It is intended to provide a comprehensive review of the topic and will incorporate the lessons learned from the Specialists' Meeting.

#### **SUPPORT PROGRAMME**

At present, the Structures and Materials Panel has responsibility for nineteen active Support Projects with the Southern Flank nations. Several of these Projects are due for completion in 1992. It is anticipated that new Projects will be approved during the remaining part of 1992 such that the Panel will continue its strong interest in the Support Programme in 1993.

PUBLICATIONS

**Introduction of Ceramics into Aerospace Structural Composites**  
Workshop Report, July 1993

**Integrated Airframe Design Technology**  
Workshop Report, July 1993

**A Recommended Methodology for Quantifying Non-Destructive Inspection  
and Evaluation Based on Aircraft Engine Experience**  
Lecture Series 190 Notes, October 1993

**An Assessment of Fatigue Damage and Crack Growth Prediction  
Techniques**  
Workshop Report, December 1993

**Characterization of Fibre Reinforced Titanium MMCs**  
Workshop Report, December 1993

## **Technical Information Panel**

Chairman : Ms. G. COTTER, US  
Deputy Chairman : Vacant  
Executive : Mr. G.W. HART, NATO

### **1993 TECHNICAL PROGRAMME**

In 1993, the Technical Information Panel will hold one Specialists' Meeting and will sponsor two publications. It will continue to give help to other Panels, particularly by compiling bibliographies for Lecture Series, and will also be involved in support to Greece, Portugal and Turkey.

#### **MEETING**

The 1993 Specialists' Meeting, to be held in Canada in the Fall, will be entitled,

#### **International High Speed Networks for Scientific and Technical Information.**

Wide area electronic networks have been developing rapidly in recent years and are being inter-linked to form an international network. Information Centres will have a tremendous opportunity to make use of these networks for the dissemination of scientific and technical information in aerospace, defence and other fields. These networks, on the other hand, give rise to many new concerns and issues. This Specialists' Meeting will include sessions describing what these networks are and how they work, discussing the management issues, describing illustrative applications, and assessing future possibilities. It will examine issues such as standards, security, management, financial/regulatory, property rights/copyright, from the point of view of the end user, the information provider and the network manager. The meeting will finish with a forum discussion intended to point the way ahead.

#### **PUBLICATIONS**

The Panel will publish an Advisory Report on Proactive Information Centres and a Guide to Sources of Information on Tenders and Contracts.

#### **SUPPORT PROGRAMME**

It is expected that support to Greece and Portugal will continue, mostly in the form of training, in those countries or in the supporting countries, of staff for the Air Force Documentation Centres that have been set up under the aegis of projects G-31 and P-74. It is believed that the Turkish Defence Documentation Centre will no longer need support under project T-74, but the Turkish authorities may make a further request for other support in this area.

PUBLICATIONS

**Proactive Information Centres**  
Advisory Report, May 1993

**Guide to Sources of Information on Tenders and Contracts**  
Report, July 1993

**High Speed Networks for Scientific and Technical Information  
Programmes**  
Conference Proceedings, November 1993

## Consultant and Exchange Programme 1993

Chief : Mr C. E. BORGEAUD, Chief Plans and Programmes  
Deputy : General G. ALEXIS (Rtd), Deputy Plans and Programmes

The Consultant and Exchange Programme was established in order to respond to requests made by the Nations and to complement Panel activities in establishing contacts between aerospace scientists and engineers in areas not always covered by the Panels.

This programme uses several main methods to carry out its mission: individual consultants, exchange of scientists and Lecture Series.

### **INDIVIDUAL CONSULTANTS AND EXCHANGE OF SCIENTISTS**

Individual consultants are specifically requested by the National Delegates of the nations concerned, by the Technical Panels and by the Military Committee through the International Military Staff (IMS).

This programme also facilitates arrangements for the exchange of scientists between research establishments or between nations, or an exchange of equipment between laboratories.

Individual consultants are made available to support the NATO Nations and also various AGARD and NATO activities. National Delegates and Panel chairmen may request individual consultants' expertise, visits and lectures by individuals or by teams of experts (Short or Special Courses) for carrying out part of their programme. Panels' Working Groups and the AASC also make use of individual consultants to support specific projects. Individuals consultants may also be requested through the IMS by other NATO Bodies. A sub-programme of Consultants for other NATO Bodies was approved in March 1988.

In 1993 the Individual Consultant and Exchange Programme will support the following 2 Special Courses organized by FDP:

- FDP Special Course No 1 "Shock Wave/Boundary Layer Interaction in Supersonic and Hypersonic Flows" in Spring at the Von Karman Institute, Belgium and in Greece.
- FDP Special Course No 2 on "Progress in Transition Modelling" in Spring at the Von Karman Institute, Belgium and in Spain.

In 1993 the Programme will also support :

- an FDP Short Course on "Aerodynamics of Manoeuvring Aircraft" given at the University of Manchester, UK and in Italy and Turkey.
- the traditional FMP Short Course on "Flight Test Instrumentation" given at Cranfield (UK) every two years in association with the College of Aeronautics.

The funding for the "Individual Consultant and Exchange Programme" in 1993 amounts to FF 2 million.

## LECTURE SERIES PROGRAMME

During the last several years six Lecture Series have been given per year. Each Lecture Series is presented for two days in three different nations (exceptionally in four locations). Occasionally 7 or 8 Lecture Series were given during one year.

For 1993 five Panels have proposed Lecture Series : AMP, AVP, GCP, PEP and SMP. Both AVP and GCP have proposed 2 Lecture Series.

The total costs planned for Lecture Series in 1993 is FF 1.5 million.

It seems probable that only the five shown below will be presented.

26-27 APRIL	TURKEY (Ankara)	SMP	Lecture Series 190 on "A Recommended Methodology for Quantifying Non Destructive Inspection and Evaluation (NDI/NDE) Based on Aircraft Engine Experience" <i>Cycle de Conférences No 190 sur "Le Projet de Méthodologie pour l'Evaluation du Contrôle non Destructif Fondé sur l'Expérience acquise sur les Moteurs d'Avions"</i>
(Mr PETRIN, US Director)			

7-8 JUNE	GERMANY (Neubiberg)	PEP	Lecture Series 188 on "Rocket Motor Plume Technology" <i>Cycle de Conférences No 188 sur "L'Etude des Jets des Moteurs-fusées"</i>
10-11 JUNE	TURKEY (Ankara)		
15-16	USA (Monterey)		

(Dr LAWRENCE, UK  
Director)

9-11 JUNE	USA (Stanford)	GCP	Lecture Series 191 "Non-linear Dynamics and Chaos" <i>Cycle de Conférences No 191 sur "La Dynamique non-linéaire et le Chaos"</i>
16-18	FRANCE		
	(Sofia Antipolis)		

(Dr PELEGRI, FR  
Director)

14-15 SEPT	US	AVP	Lecture Series 192 on "New Advances in Mission Planning and Rehearsal Systems" <i>Cycle de Conférences No 192 sur "Les Nouvelles Approches pour les Systèmes de Planification et de Simulation des Missions"</i>
11-12 OCT	NORWAY (Kjeller)		
14-15 OCT	SPAIN (Madrid)		

(Dr HUNT, UK  
Director)

25-26 28-29 OCT	PORTUGAL (Lisbon) BELGIUM (Brussels)	AMP	Lecture Series 189 on "Cardiopulmonary Aspects in Aerospace Medicine" <i>Cycle de Conférences No 189 sur "Les Aspects Cardiopulmonaires en Médecine Aérospatiale"</i>
1-2	GREECE (Athens)		
4-5 NOV	TURKEY (Ankara)		

(LtCdr GRAY, CA Director)

## **Support Programme to Greece, Portugal and Turkey**

Coordinator : Mr C.E. BORGEAUD  
Chief Plans and Programmes

Deputy : General G. ALEXIS (Rtd)  
Deputy Plans and Programmes

Project Officers : Panel Executives

This programme consists of a programme for the support of Panel Members' attendance at AGARD Panel Meetings, formerly called "Support to Nations", and a programme to support projects undertaken by Greece, Portugal and Turkey in collaboration with other nations in the Alliance, formerly called "Additional Support to Greece, Portugal and Turkey".

### **SUPPORT OF PANEL MEMBERS**

The support of Panel Members began in 1979. In 1992 the plan is to support the attendance at AGARD Panel Meetings of a large number of Panel Members from Greece, Portugal and Turkey. As in 1990 and in 1991, this support will provide travel funds and subsistence allowance for those Panel Members who are unable to be funded by their respective nations. The detailed list of supported Panel Members will be established after receipt of all the requests from Greece, Portugal and Turkey. For 1993 it is proposed to maintain the same level of effort.

### **SUPPORT PROJECTS**

The support of Projects for Greece, Portugal and Turkey by other NATO nations began in 1981. The complete list of Projects for Support to Greece, Portugal and Turkey is distributed to the National Delegates as a separate document at each Spring NDB Meeting. This list includes all the Active Projects, all the Projects still pending but expected to be underway soon because all the tentative approvals have been received, and the New Projects for which the reviews have not yet been completed by the Supported Nation, the Supporting Nation(s) or the sponsoring Panel.

The funding for the overall programme proposed for 1993 is FF 3,3 million as for 1992.

## **Military Committee Studies Aerospace Applications Studies Committee**

**CHAIRMAN : Mr Allen MURASHIGE**

### **MILITARY COMMITTEE STUDIES DIVISION**

**CHIEF : Colonel T. W. REDMOND, USAF  
DEPUTY : Lt. Col J.-R. VAISSIE, FAF  
DEPUTY : Mr A. RETSCH, MOD/GE**

### **1993 PROGRAMME**

The MCS Division will initiate two Aerospace Application Studies in 1993. These studies will be selected by the AGARD Steering Committee in September 1992 for AAS-38 and in March 1993 for AAS-39. AAS-38 will begin in January 1993, and AAS-39 in July 1993. Two on-going studies, AAS-36 "Future Use of Unmanned Air Vehicle Systems in the Maritime Environment", and AAS-37 "Options and Implications for increasing mobility by reducing dependency of NATO combat aircraft on specialized infrastructure and support", are scheduled for completion in 1993. Each study will be documented by an Advisory Report.

### **MEETINGS**

There will be two meetings of the AASC during 1993. At each meeting, the Committee will review two studies, one at mid-phase and one at final phase. Also at each meeting the Terms of Reference for the succeeding study will be finalised, and a list of study topics suggested by the Military Committee will be reviewed and prioritised for presentation at the next Steering Committee meeting. The schedule and tentative agenda for these meetings are as follows:

**AASC Meeting No 44  
(Classified)**

**June 1993, Germany**

- Final review of AAS-37
- Initial review of AAS-38
- Finalisation of Terms Of Reference for AAS-39
- Organisation of AAS-39 Study Group
- Review of proposed study topics for AAS-40

AASC Meeting No 45  
(Classified)

November 1993, United Kingdom

- Final review of AAS-38
- Initial review of AAS-39
- Finalisation of Terms Of Reference for AAS-40
- Organisation of AAS-40 Study Group
- Review of proposed study topics for AAS-41

PUBLICATIONS

AAS-35

"Potential of Reconnaissance, Surveillance and Target Acquisition (RSTA) Equipment to be Employed in the Post-CFE Environment, Including Verification, Warning and Threat Analysis".

Volume I,	NATO RESTRICTED	(English) (French)	February 1993 March 1993
Volume II,	NATO RESTRICTED		March 1993

AAS-36

"Future Use of Unmanned Air Vehicle Systems in the Maritime Environment".

Volume I,	NATO SECRET or NATO CONFIDENTIAL	(English) (French)	February 1993 March 1993
Volume II,	NATO SECRET or NATO CONFIDENTIAL		April 1993

AAS-37

"Options and Implications for increasing mobility by reducing dependency of NATO combat aircraft on specialized infrastructure and support".

Volume I,	NATO SECRET	(English)	December 1993
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**Headquarters**

**OFFICE OF THE DIRECTOR**

**MEETINGS**

National Delegates Board Meeting  
Steering Committee Meeting  
Panel Chairman's Meeting  
National Coordinators' Meeting

Bordeaux, France  
30 March - 2 April 1993

National Delegates Board Meeting  
Steering Committee Meeting  
Panel Chairmen's Meeting

Italy  
14-17 September, 1993

**PUBLICATIONS**

<u>Subject</u>	<u>Projected Publication Date</u>
Publications: 1992	March 1993
Membership Lists: 1993	March 1993
Technical Programme: 1994	September 1993
Highlights 93/1	March 1993
Highlights 93/2	September 1993

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### **III—Publications Summary**

## Summary of Proposed 1993 Publications

	<b>AMP</b>	<b>AVP</b>	<b>EPP</b>	<b>FMP</b>	<b>FDP</b>	<b>GCP</b>	<b>PEP</b>	<b>SMP</b>	<b>TIP</b>	<b>MCS</b>	<b>HQ</b>	<b>TOTALS</b>
<b>Conference Proceedings</b>	2	3	3	2	2	2	2	-	1	-	-	17
Conference Preprints	-	-	-	-	-	-	-	-	-	-	-	-
<b>AGARDographs</b>	3	-	-	5	2	2	1	-	-	-	-	13
<b>Lecture Series Notes</b>	1	1	-	-	-	1	1	1	-	-	-	5
<b>Advisory Reports</b>	-	1	-	1	1	1	1	4	1	7	-	17
Technical Evaluation Reports TER	-	-	-	-	-	-	-	-	-	-	-	-
<b>AGARD Reports</b>	-	-	-	-	2	-	-	4	1	-	-	7
<b>Others</b>	1	-	-	-	-	-	-	-	-	-	5	6
<b>TOTALS</b>	7	5	3	8	7	6	5	9	3	7	5	65